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System-integrated assessment of IT-specialist activity as an element of multilevel management

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System-integrated assessment of IT-specialist activity as an element of multilevel management

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Abstract. The system of assessments of multilevel management of multi-role activities of an IT specialist is presented. Prerequisites for the materials of the literary and analytical review for basic concepts are considered. The results include new knowledge about the connection of digitalization methodologies which are given and systemic integration, as well as their impact on the assessments sought.

1. Introduction

Each year, the processes of institutions' activities become more complex. In order to counteract the consequences of this complexity, the involvement of an IT specialist is widely used, who can not only help, but even change the execution of many of these processes with the help of digital technologies. In order to properly organize its activities in an institution such as the "Scientific and Practical Framework" (SPS), methodological platforms and tools are needed not only for digitalization, but also for consistency [1, 2]. At the same time, the SPS is understood [3] as an object, the complexity of which is associated with the main (profile) and auxiliary (management, economic, information, etc.), as well as scientific (at home or in outsourcing) activities. To work with such objects for 70 years they have been successfully applying the system approach and computer technologies. On their basis, a new discipline - system integration (SI) - has been forming lately. Its methodology and toolkit have only just been outlined, and descriptions are poorly formalized, although there are powerful prerequisites in the form of system research apparatus and modern information technology tools [4]. This process is spontaneous, so it does not sufficiently position the specifics of the SPS, problem situations and resources to solve them. It is obvious that in order to organize the activity of an IT specialist in the SPS it is necessary to assess it correctly, which is possible, for example, according to the known standards [5, 6]. However, they reflect important, but not all relevant aspects. The system-integration and management aspects of this activity are not considered.

As a development [7], this article sets and solves a task of evaluating the multilevel management of multi-role activities of IT-specialists of an institution of the SPS type, considering the interaction of methodologies of digitalization and system integration.

2. Literature and analytical review

The following key concepts are considered: establishment, management, IT-specialist, its multi-role activity, consistency.

A special role in the establishment of any type and orientation is played by the function of management, as a rule, in the terminology of management, in the best examples not forgetting the main classical elements of the management model: fixation of the initial (actual) and desired states, management (resources) and interference, dynamics and quality criteria [8]. It is known that in the conditions of the 6th technological mode of the economy [9] the interrelation of profile and IT-specialists is especially significant. At the same time, the latter can play a role in the activities of the institution [10], assessed both by the result and by the process [6].

In [3], using the formalism of IDEFØ SADT-methodology, functional models of an institution of the SPS type were constructed, reflecting the idealized state and typical disadvantages of the real state, the needs in solving the SPS problems and the hypotheses of their implementation were formulated, and the assessment of the SPS state before and after the system-integration service was given. It has been concluded that the problems of SPS have a systemic integration character and are hardly solvable from the point of view of the profile and even traditional system activities only, especially at the top management level; to counter the growing complexity of SPS and the problems of its situations, it is necessary to use the methodology and tools of SI; materials on the development, selection, analysis and bringing into the system of concepts related to the methodology and tools of SI are presented; the directions of development of SI tools on the basis of its 7-element cortege m are developed. The paper assesses the dimensionality of SI methodology and toolkit selection tasks and concludes that the materials on the subject of " SI methodology and toolkit basic concepts" are reduced into a system and are sufficient for transition to modeling and development of SI toolkit in the interests of the SPS; the large dimension of the task of SI methodology and toolkit selection complicates the practical user in the rational approach to its solution and requires development of appropriate hints. The model of SI level estimation, the system-integrated method of the solution of problem situations in SPS are developed and it is shown that the large-size problem of a choice of SI means can be rationally solved at the expense of its detailed positioning.

In [11] the system-integration paradigm as a basis for solving the problems of SPS in business is presented. The first chapter of the book contains basic definitions and graphical images of the basic concepts related to the object of the application. The second chapter gives an idea of information technologies for solving problem situations. The third introduces the concepts and capabilities of SI methodology and its tools.

In [4] it is spoken about the role of SI in software product development and the methodology of system integrator is highlighted. It is indicated that for a competent product development an IT specialist needs to see the general picture, understanding what its parts consist of and how they interact. At the same time, he does not formulate a task but understands what and how to do to solve it.

Based on these prerequisites, we have proposed, first, a package of system-structural models of the mechanism of management of IT-specialist activities of the institution and ontology of basic concepts as a basis for the assessment tool.

3. Package of system-structural models of the mechanism of management of the activity of IT-specialist of the institution

Earlier in [7] we presented a package of system-structural models of the mechanism of management of IT-specialist's activity consisting of five systems: IT-specialist's activity, multilevel management of this activity, repository of normative documents, evaluation of activity, adjustment to the specificity of a medical institution. All systems, except for the evaluation of activity, are decomposed. In development we offer the model resulted in figure 1, satisfying on a prototype to Ingve-Miller rule (no more than 7±2 elements).

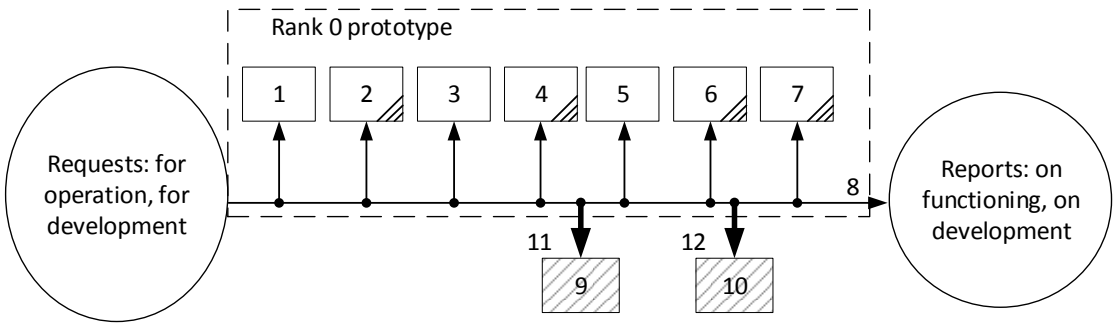

Figure 1. Systemically structured model of the mechanism of management of the IT-specialist activities of the institution according to the compilation prototype [7, 8, 12, 13] and the proposed solution: hatching, corners, bold arrows (systems: 1 - activity of IT-specialist, 2 - fixation of activity conditions in the official space of the institution, 3 - management resources, 4 - interference, 5 - multilevel management, 6 - criteria for evaluation of IT-specialist activity management, 7 - actual evaluations, 9 - system integration, 10 - adaptation, 8, 11, 12 - interfaces).

System 2 can be implemented in the formalism of a unipolar hyperboloid [12, 13], and system 4 - as shown in figure 3.

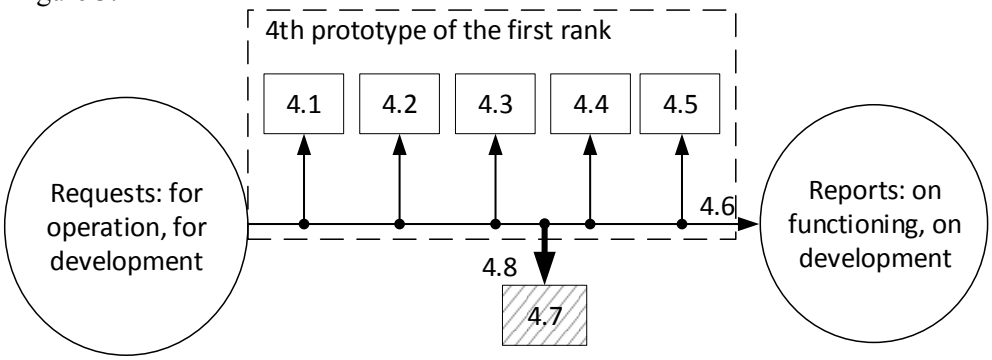

Figure 2. System-structural model of the system 4 of the interference according to the compilation prototype [14-16] and the proposed solution (subsystems of interference detection and parting): 4.1 - psychological and technological, 4.2 - internal and external, 4.3 - natural and artificial, 4.4 - deterministic and random, 4.5 - additive and multiplicative, 4.7 - weighted assessments, 4.6, 4.8 - interfaces).

For example, it is known that psychological hindrances to effective management [14] include up to 8 syndromes. To proceed to the description of the functioning of systems 6 and 7, we then proposed the author's ontology of basic concepts.

4. Ontology of concepts

Ontology is represented by a hierarchical fragment in figure 3.

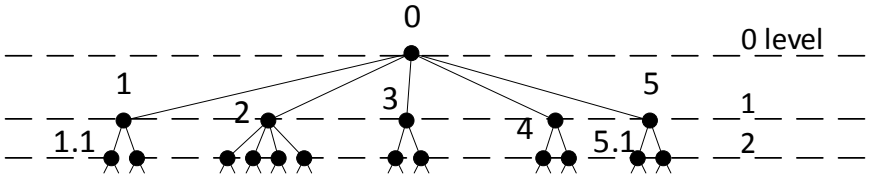

Figure 3. Fragment 1 of the hierarchy of concepts of the term "Evaluation of multi-level management of the multi-role activities of an institution's IT specialist" (0) (1 - subject of evaluation, 2 - level of objectives, 3 - means of evaluation, 4 - coverage evaluation, 5 - level of methodological

support, 1.1 - completeness of IT specialist activities, 1.2 - completeness of IT specialist activities management functions, 2.1 - state, 2.2 - sectoral, 2.3 - corporate, 2.4 - self-assessments, 3.1 - instrumental, 3.2 - expert, 4.1 - differential, 4.2 - integral, 5.1 - digitalization, 5.2 - system integration)

5. Examples of cognitive pathways on ontology

As an example, the dependence of the integrated assessment of the scope of IT management tasks (vertex 4.2 in figure 3) on the completeness of the functions of the IT specialist (vertex 1.1) and the completeness of its management functions (vertex 1.2) is considered. The latter two, in turn, depend on vertices 2.3, 3.1, 3.2, 5.1 and 5.2. The corresponding cognitive routes on ontology are shown in figures 4 and 5.

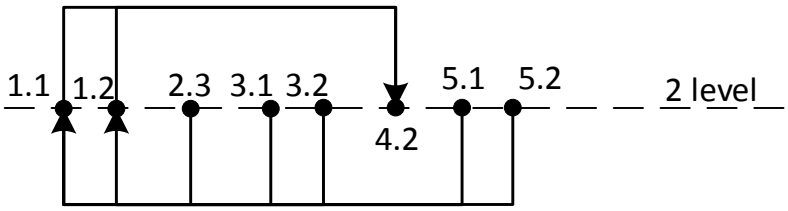

Figure 4. Example of a generalized cognitive route

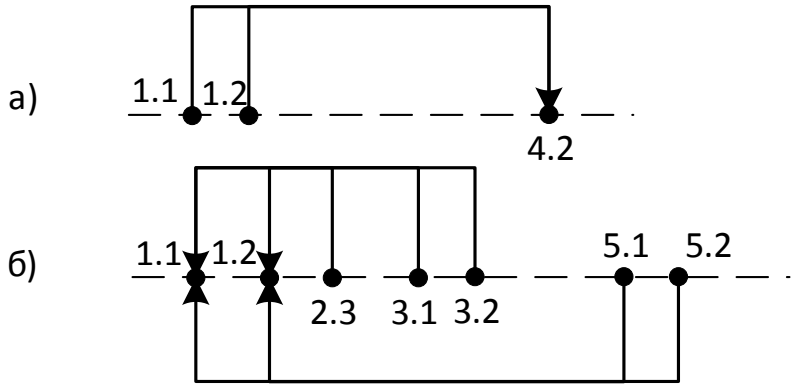

Figure 5. Private cognitive routes by rank: a - 1st, b - 2nd

On this basis, it is possible to proceed to the assessments themselves.

6. Example of estimates of cognitive pathways

The source data package for cognitive routes (figure 5) is shown in tables 1-3. As an example, we took the data from the GAUZ SO MKMTS "Bonum", Yekaterinburg.

Table 1. Weighting of αi vertices of the 1st level according to figure 3.

The name of the weight	α_1	α_2	α_3	α_4	α_5	$\sum \alpha_i$
Scale values	0,2	0,1	0,1	0,3	0,3	1,0

Table 2. Weighting of the 2nd level vertices according to figure 4

The name of the weight	α_{11}	α_{12}	α_{23}	α_{31}	α_{32}	α_{42}	α_{51}	α_{52}
Scale values	0,1	0,1	0,025	0,05	0,05	0,15	0,15	0,15

Table 3. Assessment of ontology vertexes condition along the cognitive route of vertexes of the 2nd level according to figure 4

Markings	$V_{1.1}$	$V_{1.2}$	$V_{2.3}$	$V_{3.1}$	$V_{3.2}$	$V_{5.1}$	$V_{5.2}$
Rating values	0,5	0,3	0,4	0,1	0,8	0,6	0,3

The assessment of the 1st rank routes according to figure 5a will be presented in the form of an assessment:

$$V_{4.2} = f\,(V_{1.1} * \alpha_{11} + V_{1.2} * \alpha_{12}) / \alpha_{42}. \quad (1)$$

Let's assume that f function changes linearly with coefficient one, then:

$$V_{4.2} = (V_{1.1} * \alpha_{11} + V_{1.2} * \alpha_{12}) / \alpha_{42}, \quad (1a)$$

and it's a substitution:

$$V_{4.2} = (0.5 * 0.1 + 0.3 * 0.1) / 0.15 = 0.53. \quad (1б)$$

The assessment of Rank 1 routes, considering Rank 2 routes in figure 5b, is performed under the assumption that they are of relative importance 10 to 1:

$$V_{4.2} = (V_{1.1} * \alpha_{11} + V_{1.2} * \alpha_{12} + 2 * \alpha_2 * (V_{2.3} * \alpha_{23} + V_{3.1} * \alpha_{31} + V_{3.2} * \alpha_{32} + V_{5.1} * \alpha_{51} + V_{5.2} * \alpha_{52})) / \alpha_{42} \quad (2)$$

$$V_{4.2} = (0.5 * 0.1 + 0.3 * 0.1 + 2 * 0.1 * (0.4 * 0.025 + 0.1 * 0.05 + 0.8 * 0.05 + 0.6 * 0.15 + 0.3 * 0.15)) / 0.15 = 0.78. \quad (2a)$$

Thus, the accounting for digitalization and system integration increased the score from 0.53 to 0.78.

7. Results and conclusions

- a private task was set and solved to evaluate the multilevel management of the multi-role activities of the IT-specialist of the institution such as "Scientific and Practical Structure", considering the importance of interaction between digitalization and system integration;
- a private task was set and solved to evaluate the multilevel management of the multi-role activities of the IT-specialist of the institution such as "Scientific and Practical Structure", considering the importance of interaction between digitalization and system integration;
- the ontological hierarchy of concepts of the term "Evaluation of multilevel management of multi-role activities of IT-specialist of the institution" is proposed;
- an example of a cognitive route on the proposed hierarchy is made and calculations of estimates are made;
- new knowledge about the connection between digitalization and system integration and their impact on the required assessments was obtained.

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